specific energies,'' is held by very few physiologists of the present day and still remains to be proved.

In conclusion the results of an interesting experiment performed upon cats by Langley and Anderson may be cited against the doctrine of specific energies. The cervical sympathetic nerve *contracts* the blood vessels of the submaxillary gland; the chorda tympani dilates these vessels. The cervical sympathetic was joined at its peripheral end to the chorda tympani. After union and regeneration, stimulation of the cervical sympathetic caused *dilation* of the vessels This proves that a vaso-constrictor fiber can become a vaso-dilator fiber; and that whether contraction or dilation of the blood vessels occurs depends upon the mode of nerve ending. The experiment, of course, was performed upon efferent fibers, but it is not therefore without weight in a consideration of this problem; and it is of especial value in refuting the theory that the seat of the specific energy is in the nerve fibers.

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IS INVERSION A VALID INFERENCE?

TO the old immediate inferences recent writers add inversion. The inverse of All S is P is Some S is not P. Of No $\dot{S}$ is P the inverse is Some $\bar{S}$ is P. I and O have no inverse.

Inversion violates the fundamental principle of logic and common sense that we should not go beyond the evidence. Every conclusion, in order to be valid, must be rigidly limited to the content of the premises. Its content must not be greater than that of the premises, and it must not be of a different kind. Now $\bar{S}$, the contradictory of S, is an infinite term greater than S, for it includes all the universe[1] other than S. True, it is limited by the word *Some* in the conclusion, but that fails to make the reasoning good, because $\bar{S}$ is different in kind from S. An ordinary illicit process of the minor term is indeed cured by writing *Some* in the conclusion, as in the following example: No birds are viviparous; all birds are bipeds; therefore no bipeds are viviparous. The minor term is illicit, but the fault is easily cured by writing, Some bipeds are not viviparous. But the inverse also begins with *Some*. Why, then, is it still at fault? Simply because $\bar{S}$ is different in kind. Bipeds are the same two-legged creatures in the conclusion as in the minor premise; but every possible $\bar{S}$ differs from any possible S. Let S stand for ruminants; then $\bar{S}$ will represent non-ruminants. As lambs differ from

[1] Universe here means universe of discourse.

hyenas and oxen from tigers, so every possible ruminant differs from any conceivable non-ruminant.   Inverting, All ruminants are herbivorous, we have, Some non-ruminants are not herbivorous.   In the premise we are talking about cows; in the conclusion about lions. Can we infer anything about the food of lions, or any other non-ruminant, from the fact that cows eat grass?

Of the two fundamental requirements, (*a*) the content of the conclusion must not be greater than that of the premises, (*b*) it must not differ in kind, inversion clearly violates the second.   Whether it does not also violate the first is a matter of doubt.   The non-ruminants are much the larger group, and whether those of them which are not herbivorous exceed the ruminants or not, is a question for the naturalist.   No matter how it turns out, the doubt is damning. Valid reasoning is free from any shadow of doubt.

Serious as this shadow of doubt may be, the other point, the difference in kind between the subject-matter of the conclusion and the premise, is far more damaging to inversion.   Shifting ground severs the bond of inference.   To infer the food of non-ruminants from that of ruminants would be a famous short-cut in zoology.   Such an easy royal road would be a boon to the plodding naturalist patiently studying each group for itself.

Inversion makes no pretense of limiting its conclusion to the content of its premises.   It boldly introduces new matter and is reckless in regard to quantity.   It clearly goes beyond the evidence.   The most common violation of that limiting principle of reason and common sense is illicit process—the whole inferred when only a part is given, whole and part being alike in kind.   Inversion goes one better (or worse).   The new matter of its conclusion is not represented at all in its premises—not even by so much as a beggarly "part." The only semblance of its presence in the premises arises from the common element "S" in both subjects.   But one subject is the negative, the contradictory, of the other, and negation is separation, opposition, not union or likeness.   There is not a shred of matter in the premises common to the new matter of the conclusion, not the slenderest filament of an inferential bond.   Inversion is a novel and gross form of illicit process which lugs in matter wholly new and utterly alien to the initial matter of discourse.

Bain   calls   immediate   inferences   "equivalent   propositional forms," and that phrase exactly describes the obverse or converse. But the inverse, with its injected alien matter of discourse, is very far from being equivalent to the invertend.   The cogency of the reasoning accordingly differs notably in passing from the old immediate inferences to the new.   The truth of the obverse or of the converse is obvious and indubitable.   Given, No men are immortal,

then the truth of its obverse, All men are mortal, admits no doubt. The two statements are strictly equivalent. Not so with inversion. The inverse of, All men are mortal, is, Some beings who are not men are immortal. That may be true, but its truth does not follow obviously and indubitably from the invertend. Not so easy as that is the proof of immortality. My friends all die, therefore somebody will live forever, is a wide and wild leap in the way of inference. Inversion habitually proceeds *per saltum*.

The absurdities of inversion are legion. No mathematician can square the circle; therefore some one who is not a mathematician can square the circle. No athlete can jump thirty feet; therefore some one who is not an athlete can jump thirty feet. No man can prove that two and two are five; therefore some one who is not a man can prove that two and two are five. No trouble to find absurdities. Just deny something of somebody and straightway it is true of somebody else! The trouble comes when you seek concrete examples of inversion which are not silly. Inversionists for the most part prudently stick to symbols. I am not citing these absurdities just to be witty at the expense of inversion, but because they are the superficial symptoms of deep-seated unsoundness.

Illicit process of the minor term is the salient point of my criticism. In the inverse of A there is also an apparent illicit process of the major term. Keynes and Read have attempted to explain away this weak point. I make no comment on their defense of inversion. One illicit process is quite enough, and that one to which I am now directing attention attaches not only to the inverse of A, but to every possible inverse, full or partial, derived from A, E, I, or O, for they all have $\bar{S}$ for the subject.

The advocates of inversion have two lines of proof. First in order and first in importance is the eduction series leading to the inverse by alternate obversion and conversion thus: $\text{S a P} \therefore \text{S e} \bar{\text{P}} \therefore \bar{\text{P}} \text{e S} \therefore \bar{\text{P}} \text{a} \bar{\text{S}} \therefore \bar{\text{S}} \text{i} \bar{\text{P}} \therefore \bar{\text{S}} \text{o P}$. Of this series Keynes says: "If the universal validity of obversion and conversion is granted, it is impossible to detect any flaw in the argument by which the conclusion is reached" ("Formal Logic," p. 139). There is a flaw nevertheless. The series involves the assumption that the subject may be manipulated just as freely as the predicate, despite the radical difference between them. The one is *subjectum,* something placed beneath as the foundation, the essential matter of discourse; while the other is not the initial matter of discourse, but something said about it. Substituting $\bar{S}$ for S tears up the foundation and breaks the bond of inference. But substituting $\bar{P}$ for P is harmless, provided the balance is kept true by changing the quality of the proposition. For example, Some S is P $\therefore$ Some S is not not-P. The two negatives

balance each other. But S̄, by injecting new matter of discourse, disturbs the equilibrium so profoundly that no change of quality can restore it. It is always an unbalanced negative. The deceptive semblance of balance in the double negative of the inverse (Some *not*-S. is *not* P) is unreal. The two subjects, S and S̄, being wholly different, the quality of what is said about the latter cuts no figure in restoring equilibrium. If we say Smith is honest ∴ *not*-Smith (Jones for instance) is *not* honest, do the negatives balance? Not at all. The shifting ground from one subject to another is a change so stupendous as to put out of court any question of balancing negatives. It is quite a matter of indifference whether we say Jones is honest or not honest so far as concerns any inferential relation to Smith is honest. The inferential tie, because of the change of subjects, is *nil*, and nonentity is indifferent to "is" and "is not." Just so with the change from ruminants to non-ruminants. It matters not one whit whether the latter are herbivorous or not. Changing subjects is so violent a jolt to the equilibrium that one little negative more or less in the predicate is of no consequence. Whatever concrete values we assign to S and S̄ the result is the same. They are so different that putting one for the other shatters the equilibrium so utterly that its restoration by a quality change is hopeless. The subject can not be manipulated with impunity. The basal assumption of the eduction series is fallacious. S̄ always destroys the balance, shifts the ground of discourse, brings in alien matter, breaks the bond of inference, and produces an illicit minor term. It boots not that in the eduction series S̄ first appears in the predicate. It comes back as the subject with all its sins on its head. By severing the bond uniting the last term to the first, it leaves the inverse, S̄ o P, dangling in empty space without any inferential support. The eduction series, the chief prop of inversion, is invalid.

As regards the "universal validity" of conversion and obversion, both are sound inferences so long, and only so long, as the integrity of the subject is preserved.

In the second place the inversionist appeals to Euler's circles. The inverse may be read off directly from them without any reference to the long and intricate eduction series. From the diagram of All S is P, (Ⓢp), it is obvious that Some S̄ is not P, viz., the space outside of both circles. But unfortunately for inversion, the argument proves too much. The same inverse may be read off from (S(P)), the diagram of I or O. But I and O have no business to be sporting an inverse. By definition inversion depresses quantity, and the quantity of I, or of O, is already a minimum. Yet Euler's

method is just as liberal to them as it is to A and E. Even if we bring in the four possible diagrams of I, the inverse $\bar{S}oP$ is common to all of them. In fact every possible combination of two circles leaves outside space from which to read off $\bar{S}oP$.

It may be held that this objection is not fatal. The too prolific results of the Eulerian method may be checked by the eduction series, or by definition, thus ruling out the unwelcome results obtained from I and O. But I have shown that the eduction series is itself invalid, hence unfit to serve as a standard for testing the results of another method; and the ruling out of certain results by definition is arbitrary. Logical consistency demands either the acceptance of all inverses, those of particulars as well as of universals, or else the wholesale rejection of them all.

The inversionist may claim that the facile and indiscriminate reading off of inverses from all sorts of propositions casts doubt upon the Eulerian method rather than upon inversion. In this I am very much inclined to agree with him, though meanwhile indulging the reflection that such doubt is bad for him in the end, since it undermines his second line of defense. The legitimacy of Euler's diagrams rests upon the assumption that the relations of terms may be adequately represented by their extension alone as presented to the eye by lines and spaces on a flat field. In order to read off inverses we must further assume that outside space represents the contradictory of the term in the circle, and that this contradictory exists. Here begin modern refinements to which Euler himself was a stranger. He never dreamed of bothering the pretty head of his German princess with not-S's and not-P's.

The basal assumption is sufficiently bold. Flat spaces constitute a very inadequate presentment of the intricate relations of terms each of which is rounded up into a subtile complex of qualities as well as quantity. However, so long as we limit ourselves to the inside of the simpler diagrams, as Euler did, the method has some merit. But its modern refinements are distinctly risky. Outside space is an untamed jungle full of logical pitfalls. There it lies plain and fair to the eye, therefore the contradictories of S and P exist, and their relations may be read off at a glance! Logical relations must conform to space relations! But the study of the existential import of propositions casts doubt upon the existence of $\bar{S}$ and $\bar{P}$; and the facile reading off of inversion fallacies casts doubt upon the conformity of logical relations to space relations. Conclusions read off from the outside of Euler's circles should be held doubtful unless they have been independently confirmed. In the case of the flood of inverses (no less than six may be read off from the four diagrams of I), this independent verification is not in sight. On the contrary,

illicit process taints them all.   We must discard the whole lot, or else
remand them to the chapter headed "Fallacies."

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SOCIETIES

NEW YORK BRANCH OF THE AMERICAN PSYCHOLOG-
ICAL ASSOCIATION

THE New York Branch of the American Psychological Associa-
tion met in conjunction with the Section of Anthropology and
Psychology of the New York Academy of Sciences on Monday, No-
vember 27.   An afternoon session was held at the Psychological Lab-
oratory of Columbia University, and an evening session at the Amer-
ican Museum of Natural History.   Members dined at the Faculty
Club, Columbia University.   The following papers were read:

Correlations of Association Tests: R. S. WOODWORTH.

Preliminary results with the tests of controlled association pre-
pared by Woodworth and Wells indicate rather high correlation
between the tests of similar performances.

Experiments in Progress at the University of Illinois: S. S. COLVIN.

This paper reports some of the typical experiments now in prog-
ress and partly completed, but not as yet published.   One of the most
extensive of these is the attempt to discover the effect of learning
certain motor activities on the learning of other similar activities.   It
differs principally from other studies on the transfer of training in
the large number of subjects who participated and in the attempt to
isolate the factors of accuracy and rapidity.   The experiment has
been conducted in two sections, the first with about 300 children of
the practise school of the Charleston (Illinois) Normal School, the
second with about 1,800 children in the grade schools of Blooming-
ton, Illinois.   While the results have by no means been worked out,
as far as they go they show that while there is a positive transfer
effect from the practise series to the test series in accuracy, the op-
posite is true in regard to rapidity.   The test also clearly indicates
the necessity of running a series of check experiments in interpret-
ing the results.

Another study attempts to test whether it is better to learn a
given task at one sitting or at several.   The material used in one test
was nonsense syllables.   These were learned in one, two, three, and
four periods, respectively.   The results showed that it made abso-
lutely no difference as to which method was employed.   The test is